

**ASSESSMENT OF WATER EROSION CONTROL METHODS IN RURAL  
COMMUNITIES IN UGHELLI NORTH LOCAL GOVERNMENT AREA OF  
DELTA STATE, NIGERIA**

**BY**

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BENIN CITY**

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**A PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL  
ECONOMICS AND EXTENSION SERVICES, FACULTY OF AGRICULTURE,  
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**NOVEMBER, 2025.**

## CERTIFICATION

This is to certify that the research project titled: "**Assessment of Water Erosion Control Methods in Rural Communities in Ughelli North Local Government Area of Delta State, Nigeria**" was carried out by **Jerry Otuya ASOHRO** with the Matriculation Number **AGR2000009** under the supervision of Dr. J. I Osabuohien of the Department of Agricultural Economics and Extension Services, Faculty of Agriculture, University of Benin, Edo State, Nigeria.

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## **DEDICATION**

This project is dedicated to God Almighty who made the completion of this research a reality through his love, grace, and mercies. Also to my dearest mother Mrs. Doris Efuko who did all her best to see me through school with her prayers and motivation.

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## TABLE OF CONTENTS

Title	PAGE
Cover page - - - - -	i
Title page - - - - -	ii
Certification - - - - -	iii
Dedication - - - - -	iv
Acknowledgement- - - - -	v
Table of contents - - - - -	vi
List of tables - - - - -	ix
List of figures - - - - -	x
Abstract - - - - -	xi
 CHAPTER ONE	
1.0 INTRODUCTION	
1.1 Background of the study - - - - -	1
1.2 Statement of Problem- - - - -	3
1.3 Objective of the study - - - - -	5
1.4 Justification of study - - - - -	6
1.5 Hypothesis - - - - -	7
 CHAPTER TWO	
2.0 LITERATURE REVIEW	
2.1 Concept of water erosion - - - - -	8
2.2 Water erosion control methods - - - - -	10
2.2.1 Traditional methods - - - - -	13
2.2.2 Contemporary methods - - - - -	15

2.3	Level of participation in water erosion control	-	-	-	-	-	-	19
2.4	Benefits of controlling water erosion	-	-	-	-	-	-	21
2.5	Challenges faced in water erosion control	-	-	-	-	-	-	23

### CHAPTER THREE

#### 3.0 METHODOLOGY

3.1	Study area and scope	-	-	-	-	-	-	26
3.2	Population of the study	-	--	-	-	-	-	27
3.3	Sampling technique and sampling size	-	-	-	-	-	-	27
3.4	Data collection	-	-	-	-	-	-	28
3.5	Measurement of variables	-	-	-	-	-	-	28
3.6	Data analysis	-	-	-	-	-	-	30

### CHAPTER FOUR

#### RESULTS AND DISCUSSION

4.1	Socio-economic characteristics-	-	-	-	-	-	-	33
4.1.1	Sex of respondents	-	-	-	-	-	-	33
4.1.2	Age of respondents	-	-	-	-	-	-	33
4.1.3	Marital status	-	-	-	-	-	-	33
4.1.4	Level of education	-	-	-	-	-	-	34
4.1.5	Household size-	-	-	-	-	-	-	34
4.1.6	Major occupation	-	-	-	-	-	-	34
4.1.7	Monthly income	-	-	-	-	-	-	35
4.2	Water erosion control methods practiced by respondents	-	-	-	-	-	-	37
4.3	Awareness of water erosion control	-	-	-	-	-	-	40
4.4	Level of respondents' participation in water erosion control methods	-	-	-	-	-	-	41

4.5	Training received by respondents	-	-	-	-	-	-	-	44
4.6	Possible benefits of water erosion control on rural community development								45
4.7	Challenges faced by respondents in practicing water erosion control	-							47
4.8	Test of Hypothesis	-	-	-	-	-	-	-	49

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1	Summary	.	-	-	-	-	-	-	-	54
5.2	Conclusion	-	-	-	-	-	-	-	-	55
5.3	Recommendations	-	-	-	-	-	-	-	-	56
	References	-	-	-	-	-	-	-	-	58
	Appendix	-	-	-	-	-	-	-	-	70

## LIST OF TABLES

<b>TABLES</b>	<b>PAGES</b>
Table 1: Socio-economic characteristics of respondents - - - -	36
Table 2: Frequency distribution of water erosion control methods practiced by respondents in the study area - - - - -	39
Table 3: Respondents' awareness of water erosion control methods - -	40
Table 4: Frequency and level of respondents' participation in water erosion control methods - - - - -	43
Table 5: Training received by respondents - - - - -	44
Table 6: Respondents perceived benefits of water erosion control method on rural community development - - - - -	46
Table 7: Challenges faced by respondents in practicing water erosion control -	48
Table 8: Determinant Matrix showing significant variables and Control Methods -	52

## LIST OF FIGURES

FIGURES	PAGES
Figure 1: Drainage under construction - - - - -	42
Figure 2: Mulching of a farmland - - - - -	42
Figure 3: Proper drainage and cover cropping common water erosion control methods practiced in the study area - - - - -	42

## ABSTRACT

Water erosion poses a significant threat to agricultural productivity, infrastructure, and sustainable rural development in Nigeria, particularly in regions with high rainfall intensity. This study assessed the water erosion control methods practiced by rural dwellers in Ughelli North Local Government Area of Delta State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of the rural dwellers; identify the water erosion control methods they practice; ascertain their level of participation in these practices; determine the perceived benefits of erosion control on community development; and identify the challenges faced in implementation.

A two-stage sampling technique was employed, involving the purposive selection of six erosion-prone communities (Evwreni, Uwhurun, Ohoro, Ughelli, Orogun, and Agbarho), followed by the simple random selection of 15 rural dwellers from each, resulting in a sample size of 90 respondents. Primary data were collected using a structured questionnaire and analyzed using descriptive statistics (frequencies, percentages, and mean scores) and inferential statistics (binary logistic regression) to test the hypothesis.

The findings revealed a youthful, educated, and gender-mixed population with diversified livelihoods. Respondents demonstrated high awareness (84.3%) of various erosion control methods. The most commonly practiced methods included proper drainage systems (77.8%), mulching (70.0%), cover cropping (63.3%), and construction of dams (61.1%). However, the level of consistent participation was high only for proper drainage (mean=3.47), mulching (3.28), vegetative cover (3.22), and cover cropping (3.02), while more structural methods like terracing, contour farming, and dam construction recorded low participation. The primary perceived benefits of erosion control were reduced flooding (95.6%), enhanced agricultural productivity (85.6%), and protection of infrastructure (82.2%). Major constraints to adoption were lack of materials (81.1%), lack of funds (75.6%), time constraints (74.4%), and poor government support (73.3%).

The binary logistic regression analysis revealed a significant relationship between specific socio-economic characteristics (such as age, household size, primary occupation, and income) and the adoption of certain erosion control methods. For terracing; age ( $p=0.043$ ), household size ( $p=0.044$ ), primary occupation ( $p=0.011$ ), for zero/reduced tillage; household size ( $p=0.078$ ), primary occupation ( $p=0.031$ ), for proper drainage system; household size ( $p=0.088$ ), for vegetative cover; age ( $p=0.087$ ), primary occupation ( $p=0.081$ ), income ( $p=0.019$ ), for construction of dams; sex ( $p=0.033$ ),

income ( $p=0.050$ ), for building raised platforms; sex ( $p=0.056$ ) and for agroforestry; age ( $p=0.093$ ) leading to the rejection of the null hypothesis. The study concludes that while rural dwellers in Ughelli North are knowledgeable about erosion control, a significant gap exists between awareness and consistent implementation, driven largely by socio-economic and institutional constraints. It is recommended that government, development agencies as well as local community leaders enhance capacity building through practical training, provide financial subsidies and materials, strengthen extension services, and promote community-based approaches to bridge the knowledge-practice gap and ensure sustainable land management in the region.

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background of Study

The process of erosion involves the transportation of soil and rocks by natural elements like wind or water. A similar process called weathering breaks down or dissolves rock, but it doesn't involve movement. Erosion is when soil and rocks are worn away and moved to another place, while deposition is when these materials are added to a land area. Most erosion happens because of water, wind, or ice, like glaciers. Water erosion happens when water, like rain or melted snow, washes away the top layer of soil. This can occur because of things like irrigation, runoff, and not managing water properly. Basically, rainwater is usually the main cause of this problem (Sergieieva, 2024). This process happens when water flows over or seeps into the soil, taking away soil particles and changing the land in different ways. Each way of changing the land helps to cause land damage and reduces the land that can be used for farming. For example, water erosion affects the world's food supply by decreasing the amount of land that can be farmed. Studies show that soil erosion can cause a 0.3% drop in global crop production each year (Sartori et al., 2019; Borelli et al., 2020).

Water erosion occurs due to the interaction between climate conditions and the characteristics of the land. This creates complex relationships between soil and water, resulting in different types of erosion, each with its own shape and characteristics. Sheet erosion is a process where topsoil is washed away in even layers by raindrops and water

running off the surface. This often leads to a big loss of soil nutrients before people notice any changes. Rill erosion happens when water gathers in small channels. If these channels are not addressed promptly, they may escalate and lead to more severe erosion issues. Gully erosion is a serious type of soil erosion that happens when water flows over the ground and carves out big ditches. This can make the land unusable for farming and lead to important changes in the environment and water systems. Streambank erosion happens mostly because of the force of moving water. It changes the shape of riverbanks and affects nearby land, impacting both land and water environments (Krzeminska et al., 2019; Okeke et al., 2020).

Water erosion control means using methods to stop or lessen the loss of soil caused by water from rain, runoff, or flowing streams.

Methods like changing where crops are planted, using plants to cover the soil, and minimizing how much the soil is disturbed can greatly lower soil erosion by boosting the soil's organic matter and keeping it healthier. These practices help keep the soil good at soaking up water, which reduces the chances of water running off and causing erosion. Also, planting more trees or restoring forests helps keep the soil in place, protects it from wind, and allows more water to soak in. This is very important for lowering the chances of erosion (Peña-Lévano et al., 2019, Maltsev & Yermolaev, 2020).

Effective soil management techniques assist in stabilizing soil, reducing water runoff, and promoting sustainable land practices (Morgan, 2005). Farmers are encouraged to keep using good methods for saving soil and water to help prevent water erosion. Using

terraces on steep farms and building good drainage channels to direct heavy rainfall away safely will help reduce water erosion in the area we studied (Ominikari & Bethel, 2023). According to Auerswald (2008), enhancing the soil cover across various regions over time is the most effective method for minimizing soil erosion. This can be done well by using no tillage, less tillage, or mulch tillage. Other ways to control water erosion are: making flat steps on slopes, having good drainage systems, using cover crops, and farming along the shape of the land, among others. Controlling water erosion is important for fighting against land damage caused by water. The ways to solve water erosion problems vary based on the kind of soil, land shape, weather, types of crops grown, and how the land is used (Sergieieva, 2024).

## **1.2 Statement of Problem**

Water erosion is a big environmental issue. It can damage soil, reduce farm productivity, and harm buildings and natural habitats. According to the Food and Agriculture Organization (2019), there is a universal consensus among scientists that soil erosion is a significant environmental challenge in today's world. It reduces how much food we can grow, harms the environment, increases the risk of floods and landslides, and in serious cases, can force people to leave their homes.

The process of erosion from water running off the surface changes over time and can create small channels called rills and larger ones called gullies, which show that erosion is getting worse. Rills are thin paths made when water runs off and gathers in certain ways, which wears away the soil and makes the path deeper. These small streams can

change into bigger channels called gullies, which are much larger and deeper, sometimes several meters wide and deep. Gully erosion is a big change in the land that causes a lot of soil to wash away and makes the land harder to use (Yuan et al., 2022; Van Leeuwen et al., 2019).

Gullies move a lot of soil and dirt downriver, which can harm farming and cause more damage to the land.

This can result in more water running off and less water soaking into the ground around it. This type of erosion is very harmful because it triggers more erosion, causing quick and large changes to the land. To stop the first small channels (rills) from forming and turning into bigger ones (gullies), it is important to manage how water flows over the surface (Bollati et al. , 2019)

Subsurface flow can greatly affect soil stability, especially in places with lots of rain or quick snow melting. In these areas, the amount of water flowing through the soil can rise a lot, making leaching and the weakening of the soil worse. Soils that let water pass through easily, like sandy or loamy soils, are particularly at risk because their big gaps let water move quickly (Zhu & Zhang, 2019; Guzzetti et al. , 2022). This extra movement weakens the soil inside and makes the top layer easier to erode in other ways. For instance, if the lower layers of soil lose their strength, the upper soil becomes more prone to sliding, particularly on slopes during heavy rainfall.

Furthermore, the alteration of subsurface water dynamics can affect the surface runoff patterns, often leading to increased erosion elsewhere as water exits the soil system more

quickly, carrying soil particles with it (Sene, 2024; Fan et al., 2019). A key threat to land degradation worldwide, soil loss by water erosion could grow by up to 66% over the period 2015-2070 (The Joint Research Centre, 2024).

This study aims to answer the following research questions:

1. What are the socio-economic characteristics of rural dwellers?
2. What water erosion control methods are practiced by rural dwellers?
3. What is the level of rural dwellers participation in water erosion control?
4. What are the possible benefits of water erosion control methods on rural community development ?
5. What are the challenges faced by rural dwellers in practicing water erosion control ?

### **1.3 Objective of the study**

The general objective of this study is to assess the water erosion control methods practiced by rural dwellers in Ughelli North Local Government Area, Delta state.

The specific objectives are to:

1. describe the socio-economic characteristics of rural dwellers;
2. identify water erosion control methods practiced by rural dwellers;
3. ascertain the level of rural dwellers participation in water erosion control;
4. determine the possible benefits of water erosion control on rural community development;
5. ascertain challenges faced by rural dwellers in practicing water erosion control.

#### **1.4 Justification of study**

Water erosion is a big problem for the environment, especially in rural areas. Farming, cutting down trees, and bad land management make the soil worse (Pimentel & Burgess, 2013). Evaluating the performance of erosion control strategies in rural areas is crucial. This helps ensure sustainable land use, food security, and reduces poverty. Soil erosion causes the loss of rich topsoil, which makes it harder to grow food and can lead to food shortages (Lal, 2001). Rural communities, which predominantly rely on subsistence farming, are disproportionately affected. Implementing and assessing erosion control measures—such as terracing, contour plowing, and agroforestry—helps preserve soil quality and maintain crop yields (Morgan, 2005). Without proper evaluation ineffective practices may persist, worsening land degradation.

Eroded sediments often end up in water bodies, causing siltation, reduced water quality, and ecosystem damage (Walling & Fang, 2003). Every year, 75 billion tons of good soil is washed away from the earth due to erosion. As a result of this, valuable soil that we need to protect for the future is getting smaller and smaller. Every year, around 12 million hectares of land are lost (FAO and IAEA, 2017). Effective erosion control improves livelihoods by stabilizing farm incomes and reducing rehabilitation costs (Nyssen et al., 2004). Assessing community-based interventions ensures local participation and cultural appropriateness, enhancing adoption rates (Pretty et al., 2006).

Governments and NGOs need evidence-based data to prioritize erosion control investments (World Bank, 2008). Reviewing different measures provides policymakers with insights into cost-effective strategies, ensuring sustainable rural development.

This study aims to give a deeper insight on how rural dwellers in Ughelli North L.G.A practice effective water erosion control, emphasizing the challenges they face and how these findings can be used to offer effective and realistic recommendations to policymakers, development agencies, and stakeholders involved in land, soil and water conservation initiatives. By thoroughly accessing the water control measures in rural communities, this research has the potential to improve their livelihoods and contribute to community development goals in this region.

### **1.5 Hypothesis**

The hypothesis is stated in the null form.

H<sub>01</sub>: There is no significant relationship between the socio-economic characteristics of rural dwellers and water erosion control methods practiced.

## CHAPTER TWO

### 2.0

### LITERATURE REVIEW

#### 2.1 Concept of water erosion

Water is the main cause of erosion on Earth. Rain, rivers, floods, lakes, and the ocean move soil and sand and slowly remove dirt from the ground. Rain causes four kinds of soil erosion: splash erosion, sheet erosion, rill erosion, and gully erosion. There are several types of soil erosion caused by water. These include (1) splash erosion, (2) sheet erosion, (3) rill erosion, (4) gully erosion, (5) ravine erosion, (6) landslides, and (7) stream-bank erosion. Splash erosion is when raindrops hit the ground and break soil apart, causing small pieces to be moved away. Sheet erosion is when a thin layer of fertile soil is washed away from large areas, like fields, during rain. This happens often when rainwater flows over the ground. This kind of erosion is sneaky because it makes it hard for a farmer to notice how bad it really is. It is also called the farmers' death. When water starts to flow, it shapes the land, and the wear down of the ground is no longer even. Raindrops don't directly pull any particles off the ground in small channels called rills, but they do make it easier for the flow of water to carry them away. Rills are small grooves in the soil that can be fixed by regular farming practices.

Gully erosion is a type of erosion that happens when heavy rain and fast-moving water create deep trenches or channels in the ground called gullies. Gullies can be shaped like a "V" or a "U. " Gullies divide the big fields into small pieces, and over time, make them unsuitable for growing crops. Continuous flow of water through gullies further deepens

the grooves and may ultimately result in ravines. Ravines are 15 to 30 cm in deep and with steep vertical sides while 'Ravines erosion' is prolonged and advance stage of gully erosion leads to ravines found in deep alluvial soils. It is nothing but deep and wide gullies. Landslides or slip erosion is caused by heavy rainfall and it occurs in sloppy lands, such as mountains and hilly areas with slope is  $>20\%$ . In this type of erosion when the running water percolates through the crevices of rocks great masses of soils and loose rocks lying on the steep slopes slip downward. The immediate cause of a slide may be an earthquake, or a heavy rainfall, which unduly saturates the ground or part of road.

On the banks of swollen rivers it is most active. During the rainy season when fast running water streams take turn in some other directions, they cut the soil and make caves in the banks. As a result of this, quite often large masses of soils become detached and washed away from the banks and are deposited at places in course of streams, hence stream bank erosion occurs. Water erosion occurs when rain or snowmelt displaces the soil on the ground. The more water flowing over the land, the more soil particles are moved or transported away (NRDC, 2021). Soil is a major natural resource for life on earth and provides a wide range of ecosystem services for humans (García-Ruiz et al., 2015). Rainfall-induced soil erosion is the most important type of soil erosion, and it includes the following two distinct processes: the detachment of soil particles caused by raindrop splashing and the subsequent scouring of surface runoff or laminar flow (Alavinia, Saleh & Asadi, 2019).

Rainfall represents the main driving force of water erosion. Rainfall characteristics, such as the rainfall amount, duration, intensity, kinetic energy, and erosivity, notably affect runoff and soil erosion processes (Duan et al., 2021; Zhu et al., 2021; Wang et al., 2021). Many studies have shown that rainfall type greatly affects runoff and soil erosion (Chen et al., 2018; Huo et al., 2020). Knowledge of rates of soil erosion by water is important for two principal reasons. First, it is essential to our understanding of landform development. Secondly, on agricultural land, these rates determine the long-term sustainability of agricultural practices and have profound economic consequences (Pimentel et al., 1995). In turn, these consequences influence policy on erosion control. Determination of these rates is typically obtained from short-term measurements made on run-off plots (of a few square metres) or via equations that predict soil erosion, which are themselves calibrated using data from such plots. However, both to understand the role of soil erosion in landform development and to use these rates for erosion control requires that the plot data be extrapolated both to longer time-scales than the period of measurement and to larger areas than those of runoff plots. Such extrapolation has proved problematic (Parsons et al., 2002).

## **2.2 Water erosion control methods**

Ciolfi (2021) opined that water erosion causes a variety of adverse effects to land and soil, especially the soil's ability to retain water and nutrients. When soil is impacted this way, the land also becomes more susceptible to flooding and soil degradation. This occurs when water sweeps away the topsoil, disrupting and leaving behind only the layers

of subsoil, which generally contain fewer of the minerals and nutrients that crops, shrubs, and grasses of all kinds rely on to grow well. As a result, learning how to prevent water erosion can be one of the most beneficial things you do to protect land from these damaging effects. One of the most important steps you can take to prevent water erosion is to plant in the areas experiencing the most erosion (Ciolfi, 2021).

There are many different kinds of plants to choose from, however trees and shrubs are the heavy lifters when it comes to preventing water erosion of the soil. Tree roots help stabilize the soil by holding it in place during heavy rains, preventing a lot of runoff that can happen in the rainy months. Shrubs with extensive root systems can also help prevent soil degradation and runoff in a similar way. Managing rain water erosion and runoff effectively can also be accomplished by creating pathways for water to divert, or properly drain, from areas that are highly-prone to erosion like steep slopes or embankments. Digging a ditch, shallow trench, or even a french drain may be a useful way to create a water diversion, while gutters and piping can provide a streamlined solution if space is tight (Ciolfi, 2021).

Techniques such as crop rotation, cover cropping, and conservation tillage can significantly reduce the rate of soil erosion by improving soil organic matter and reducing soil disturbance (Firoozi & Firoozi, 2024). These practices help maintain the soil's ability to absorb water, reducing runoff and the potential for both splash and sheet erosion. Additionally, maintaining and increasing vegetation cover through afforestation or reforestation efforts can stabilize the soil, reduce wind exposure, and increase water

infiltration, all of which are crucial for reducing erosion risks (Peña-Lévano, Taheripour & Tyner, 2019; Maltsev & Yermolaev, 2020). Effective erosion management necessitates supportive policies and active community involvement alongside technical solutions. Enforcing land use planning, regulating agricultural practices, and incentivizing erosion control measures are fundamental (Firoozi & Firoozi, 2024). For instance, the recent adoption of the European Union's Soil Thematic Strategy effectively integrates land management with agricultural practices to significantly reduce erosion, demonstrating a marked improvement in affected regions (Gutierrez et al., 2023; Wang, 2022).

Community engagement in these initiatives is crucial for tailoring solutions to local conditions and ensuring their long-term viability (Firoozi & Firoozi, 2024). Moreover, targeted education and outreach programs have proven effective in increasing awareness and promoting sustainable practices across communities, as seen in the successful implementation of the 'Water Friendly Farming' initiative in the UK, which has led to improved water quality and soil stability (Giller et al., 2021).

Addressing water erosion requires a comprehensive strategy that combines effective solutions, regulations, and community engagement. This overall plan makes sure that we manage erosion in a way that lasts and works well, tackling both the reasons for erosion and its effects (Firoozi & Firoozi, 2024). Communities can take care of their natural resources, keep farming practices strong, decrease the chance and impact of natural disasters, and create strong buildings that can handle erosion by using good management plans. These strategies work together to create a strong plan for dealing with the different

problems caused by water erosion. This contributes to a better existence for nature and humanity alike (Rigden et al., 2020; Zhang et al., 2019).

### **2.2.1 Traditional methods**

According to Firoozi & Firoozi (2024), traditional erosion prevention methods have evolved over time, grounded in a deep understanding of and relationship with the surrounding landscape. These ways of doing things have been passed down over the years, showing a deep link between people and their surroundings. They focus on using simple and cheap methods that improve the health and productivity of the soil, using materials that are found nearby and local knowledge. Combining these traditional methods with modern strategies can create a complete way to manage land sustainably (Wen & Zhen, 2020; Adade Williams, Sikutshwa & Shackleton, 2020). Some of these traditional methods include:

#### **Terracing**

Terracing is an old farming method that people have used for thousands of years in different places to prevent soil from washing away on steep hills. Terracing is an old method used to save water and soil. It is often found in hilly and mountainous areas where many people live (Deng et al. , 2021). Terraces are flat areas made on sloped land to make more space for farming and to save water and soil. Terracing has worked very well in different areas, like the famous rice terraces in the Philippines and the farming terraces in the Andes. It has been important for helping local farming in difficult landscapes (Sakellariou et al., 2021; Rutebuka et al., 2021).

## Contour ploughing

Contour ploughing is a method used in Grenada to help protect the soil from damage caused by natural disasters. It helps keep the soil healthy and strong. By plowing along the shape of a hill instead of going straight up and down, this method helps prevent water runoff. It forms natural obstacles that reduce water flow, allowing a greater amount to be absorbed by the soil (Firoozi & Firoozi, 2024). Contour plowing is usually used along with other methods like strip cropping, which means planting different crops in alternating rows. This contributes to maintaining soil stability and minimizing erosion. This method has worked well in different areas by greatly reducing soil loss and helping to save water on hilly land (Jia et al., 2020; Khokhar et al., 2021).

## Use of cover crops

Cover crops, like beans and grains, are planted to keep the soil safe from washing away, improve the health of the soil, and control pests, including weeds.

Planting cover crops is an important part of protecting the soil, especially in areas where the soil is at risk of washing away. Besides providing protection, cover crops help make the soil stronger. Their roots hold the soil together, making it less likely to wash away. Additionally, when these crops break down, they add nutrients to the soil, which makes it healthier and better for growing plants (Firoozi & Firoozi, 2024). Using cover crops to prevent soil erosion is known to be helpful. They work well in both small gardens and big farms, making the soil healthier and reducing erosion (Koudahe, Allen & Djaman, 2022; Adetunji et al. , 2020).

Mulching is a good way to prevent water erosion. Most types of mulch can soak up water, but the amount they can absorb varies based on the type of mulch used (Ciolfi, 2021). Small pieces of hard tree bark used as mulch can soak up a lot of water and are a good option to stop soil from washing away. Wood chips can help keep rainwater in the ground and stop soil from washing away. Straw mulches are also good for keeping soil wet and protecting it from being eroded by raindrops. These traditional practices show how old methods, created from careful observation and local understanding, are still important for conserving soil today. By using these methods in today's farming, we can greatly lower soil erosion, manage water better, and boost farm productivity (Firoozi & Firoozi, 2024).

### **2.2.2 Contemporary methods**

The approaches to managing water erosion have evolved from traditional local practices to the adoption of modern technologies and scientific concepts. This has led to better solutions that fit the challenges of today's landscapes. These methods use the latest developments in materials, engineering, and farming to provide accurate, adjustable, and effective ways to fight erosion (Firoozi & Firoozi, 2024).

According to Firoozi & Firoozi (2024), new methods such as using geotextiles, hydroseeding, and rainwater collection are big improvements in how we can protect and restore land quickly and effectively. By using modern tools along with traditional methods, we can make erosion control more effective and sustainable. This approach helps meet current needs while also aiming for long-term environmental goals (Andreeva et al., 2021; Han et al., 2020).

## **Geotextiles**

Geotextiles are substances designed to separate various soil layers. They are used to make slopes stable, support plant growth, and prevent soil erosion. Geotextiles are commonly used to prevent soil erosion on land that has been changed by humans. Geotextiles are materials made from either man-made or natural sources. They act as a protective cover for the soil and do several important jobs: they keep the soil from washing or blowing away while still letting water seep into it. This is important for keeping the water cycle in balance (Firoozi & Firoozi, 2024). Natural fibers work better than man-made ones at preventing erosion (Sutherland and Ziegler, 1996). They are better liked because they can completely break down in nature and stick to the soil more effectively (Langford & Coleman, 1996). Using geotextiles is a smart decision to fight erosion because they quickly help stabilize the ground. This is especially important in places where soil can be damaged quickly.

Geotextiles are placed over the soil to protect it and make it stronger, while also allowing water to pass through. This demonstration shows how important they are for keeping the soil safe in places that can easily erode, especially where just having plants isn't enough (Markiewicz et al. , 2024) This way of managing water erosion is hardly used in Nigeria..

## **Hydroseeding**

Hydroseeding is a method of planting where a mixture of water and seeds is sprayed onto the ground to help plants grow (Adams, 2021). This mix helps to quickly grow plants, which is important for keeping the soil stable. Hydroseeding is especially helpful for big

areas or places that are hard to get to, where normal planting methods are not easy to use (Firoozi & Firoozi, 2024). Hydroseeding is commonly used in areas after buildings are constructed and on sloped roadsides. It is an effective and affordable method to make these areas look nicer and to prevent soil from washing away (Kettenring & Tarsa, 2020; Emeka et al. , 2021).

There are many types of plants to pick from, but trees and bushes are the best at stopping soil from washing away (Ciolfi, 2021). Tree roots keep the soil stable by holding it in place during heavy rains. This stops a lot of water from running off, which can happen when it rains a lot. Shrubs with strong root systems can do the same thing and also help stop soil from getting damaged (Ciolfi, 2021). This method is very important for quickly growing plants on hard-to-reach areas, which helps prevent soil from washing away (Wersebeckmann, Entling & Leyer, 2022).

### **Rainwater harvesting and diversion structures**

Today, controlling erosion means carefully managing water flow by using rainwater collection systems and building structures to redirect water. Rainwater harvesting systems gather and keep rainwater for later use. This helps reduce the need for groundwater and decreases surface runoff, which is a major cause of erosion. Small farmers, especially those who farm on hilly land, could gain the most from collecting rainwater. This assists them in gathering runoff water and lessening the impact of soil erosion.

Diversion structures are built to direct extra water away from places that could get damaged. They help manage how fast the water flows, which can reduce the power of moving water, especially in areas that get a lot of rain. By controlling how water moves with the land, these methods not only stop soil from washing away but also make better use of water in farms and cities. This helps make the environment stronger and more sustainable against erosion (De Sá Silva et al., 2022; Nabi et al., 2020).

### **Integrating management practices**

To manage soil erosion well, we need to use a combination of old and new methods together. According to Firoozi & Firoozi (2024), it is crucial to integrate these initiatives to enhance soil conservation and address the numerous issues resulting from erosion. By joining old knowledge with new technology, experts can create strong and flexible solutions that fit the unique needs and challenges of different environments (Blake et al. , 2021; Ngabire et al. , 2022). Traditional practices often use local knowledge that has been around for a long time and usually fit well with the culture and environment of a place. When you mix these with the accuracy and speed of new technologies, you get a better plan for controlling erosion that uses the best parts of both methods. For example, using hydroseeding can quickly grow plants on terraced land, which helps to secure the soil faster than using regular methods (Zhang et al., 2022; Singh et al., 2019).

### **Enhanced soil health and productivity**

Healthy soils hold more water, help plants grow strong, and are better at stopping erosion. Methods that add more organic matter to the soil, like using cover crops, work well with

other methods such as terracing or building barriers. These approaches help improve the quality of the soil and make it stronger against erosion (Karlen et al. , 2019; Kader et al. , 2019).

Getting involved in the community and helping with rules and decisions.

The success of using different methods to prevent erosion largely depends on community participation and good government support (Firoozi & Firoozi, 2024). Involving local communities in planning and carrying out projects makes sure the strategies fit their needs and have their approval. In addition, reforming beneficial guidelines that promote proper land utilization and securing financial support for soil erosion prevention can enhance these initiatives, facilitating the broader adoption of effective management techniques (Rangel-Buitrago, Neal & de Jonge, 2020; Waylen et al., 2020).

### **2.3 Level of participation in water erosion control**

Studying soil erosion has become very important because it can harm land and reduce crop growth. Around the world, nearly 80% of the damage to farmland is due to soil washing away. Earlier studies have shown that farmers play an important role in taking care of the land. They help achieve sustainable land use and protect soil and water by preventing soil erosion. However, these studies were done in different settings, and none of them looked into how communities see soil erosion or how much they are involved in protecting the soil to reduce the social, economic, and environmental effects of soil erosion in the area studied (Ofgeha, 2016). According to Ofgeha's study (2016), 87% of

farmers are of the opinion that erosion is manageable, while a mere 23% disagree and believe it cannot be managed.

Jaspers (2003) says that integrated water resources management means taking care of both above-ground and underground water. It focuses on the quality, amount, and environment of the water, using ideas from different fields and involving various people in the process. In the past, efforts to develop and manage conservation projects focused mostly on fixing technical issues. They paid little attention to the social aspects, like fairness in who gets to participate, make decisions, and access resources.

Community participation involves coming together to discuss and exchange ideas with fellow community members as well as with government representatives or non-profit groups. The goal is to help come up with ideas that can be used to improve policies and how things work. Carr (2015) found that getting people involved can improve river basin management by: (1) discussing and agreeing on better choices, (2) building and using people's skills and connections for better decisions and actions, and (3) making decisions more trustworthy to help them get put into action. The river basin is a useful area for managing soil erosion and the movement of sediment. This is because the way the river basin is shaped affects how soil, water, and sediment move around.

People often struggle to take part in water management programs because they don't have enough information, are not very willing to get involved, and there isn't a well-organized way for them to participate. Getting involved helps share responsibility in community development and ensures it lasts over time (Cherono 2019). This study aimed

to look at the social and economic reasons that affect why farming families take part in soil erosion management (Cherono et al., 2019).

According to Cherono et al. (2019), Engaging everyone ensures that the responsibility for development plans is collectively shared, which enhances their sustainability. It plays an important role in planning, carrying out, checking, and looking after these plans, which helps improve the community. Due to a lack of understanding about their roles and responsibilities as important members, individuals in the rural community find it difficult to actively participate in initiatives to combat soil erosion.

#### **2.4 Benefits of controlling water erosion**

Water erosion has serious effects on the economy and society. It impacts how much food we can grow, the safety of buildings and roads, and the strength of communities. As the quality of soil gets worse and land becomes less stable, communities struggle to keep farming and maintain safe buildings and roads. According to Charles and others. Soil and water conservation means any method that helps stop soil from washing away and keeps rainwater from running off too quickly. This helps protect the soil. Land degradation was a big problem around the world in the 20th century and is still very important in the 21st century. It impacts the environment, farming, food supply, and people's quality of life. Soil degradation happens when the top layer of soil is washed or blown away by water or wind. It can also occur when the soil loses nutrients, becomes hard and compacted, or when the variety of living things in the soil decreases (Lal, 2001). Soil erosion poses a

significant issue that deteriorates soil quality, resulting in challenges for crop growth in tropical and subtropical regions (Ahuchaogu et al., 2022).

Contour farming is a popular method used to protect soil and water in hilly areas and sloped land. All the farming activities such as Plowing, planting seeds, and caring for crops are done along the shape of the land. The bumps and grooves created across the slope act like small walls that slow down the water flowing over the land. This helps to lower soil erosion and keeps nutrients in the soil (Dimelu et al. , 2013; Liu et al. , 2014). In areas with limited rainfall, it aids in retaining soil moisture since water is absorbed more effectively and takes longer to drain away. In areas with a lot of rain, it prevents soil from washing away. In both cases, it helps stop soil from washing away, keeps the soil healthy and wet, and makes crops grow better. But how well this method works depends on how heavy the rain is, the kind of soil, and the shape of the land in that area (Ahuchaogu et al. , 2022).

Mulching stops hard crusts from forming after it rains. Using blade harrows between rows of plants or during other farming tasks creates a "dust mulch" on the soil surface. This helps break the connection of tiny tubes that carry moisture in the soil, which reduces water loss from evaporation. Mulching helps to keep weeds away and also keeps the soil moist and healthy. So, it can be used in areas with a lot of rain to reduce the loss of soil and water, and in dry areas to help keep the soil moist (Gill & Robert, 2010; Prats et al., 2016).

Mechanical methods like bunds, terraces, waterways, and features such as plant barriers or stone lines set up on farms can help slow down wind and reduce water runoff.

This helps prevent soil erosion (Morgan, 1995). Contour bunds are made from soil or stones and have a channel dug out with a bank or ridge on the downhill side. They help farmers grow crops and are long-lasting ways to prevent soil erosion. The initial ones are located on gradual inclines, whereas the latter are positioned directly at a right angle to the steepest sections of the hills. Couper (1995) studied contour banks and found that they are helpful in preventing gully erosion, which is a serious type of erosion. Level terraces can lower water runoff by 92% and prevent soil loss by 87-95%. Graded terraces can reduce runoff by 77-92% and soil loss by 98% (Charles et al. , 2019). Soil erosion will have an impact on future land use changes that occur as a result of climate change. Different ways of managing land in river areas affect soil erosion. However, there are not many studies that look at how changes in these land management practices impact soil erosion (Abeysingha & Ray, 2025).

However, Pandey et al. (2021), researchers used good farming methods like building recharge structures, contour farming, filter strips, porous gully plugs, zero tillage, and conservation tillage to study soil erosion and possible future changes in the Tons river basin in India. They noticed that the recharge structure was the best solution, reducing sediment by 38.98% in the past and by 37.15% in future situations. Good management practices can help keep nature healthy, improve farming, reduce the chances of natural disasters like floods, and protect important buildings and systems. These initiatives

contribute to reinforcing and enhancing the economic stability of communities that are experiencing erosion (Jha et al., 2019; Ferrara et al., 2020).

## **2.5. Challenges faced in water erosion control**

The absence of necessary resources to combat erosion has significantly impacted farmers ( Nwobodo et al. 2018). They often have to rely on local materials to fight erosion, but these are usually not very effective. The cost of using erosion control methods is a big problem for farmers. Due to insufficient income to support their families, they are unable to invest in effective erosion control methods. As a result, they have to use cheaper methods that might not work well. This research lacked substantial details regarding the issues associated with implementing water erosion control techniques. The main emphasis was on agricultural producers and the broader rural population.

Thus far, research pertaining to ecosystem management has largely emphasized tangible aspects and their measurements. Only a few have looked into the social and economic factors that influence decisions. So, how much people invest in managing soil erosion can be affected by their life situation. This includes social factors like age, gender, family size, education, and economic factors like the size of their land, income from farming and other jobs, the cost of tools and technology, and how easy it is for them to get loans (Cherono et al. , 2019). Most farmers in the area 32.5% reported that they are unable to maintain their land due to a lack of financial resources. The second reason, mentioned by 28.3% of them, was being poor. Likewise, 12.5% of the people said the issues were due to rules and policies. Only 11.2% linked the problems to the physical features of their land, 9.

2% mentioned the weather conditions, and 5.8% connected it to how well off-farm activities (non-agriculture jobs) worked for them (Ofgeha, 2017).

Drainage systems move excess water away from hills and into valleys, where it flows into a stream or river.

It can be real or man-made and is often made strong with grass, rocks, brick, or concrete. Reinforced concrete channels are better, but small farmers don't use them much because they are too expensive.

Using local materials at selected dam sites can save money and still get the right outcome. It can be seen that the project would only cost a fifth of what was estimated because there were building materials nearby. The main reasons for this failure are poverty, lack of interest, and a growing population. Poverty leads to a significant portion of the population being illiterate, lacking disaster management skills, using ineffective farming techniques, and having poorly constructed drainage systems. These issues make it hard to control erosion in Nigeria. Different levels of government don't seem to care about erosion problems, and young people aren't interested in working in the field of geo-disaster management. This has made it harder to effectively control erosion (Igwe & Fukuoka, 2010).

A study by Gemechu and Hunde (2015) found that the two main types of soil erosion are caused by water and wind. The study found that water erosion is the biggest problem in all the areas examined. It is worse in the highland areas of Kofele and Shashemene, where 90% and 77.5% of farmers, respectively, are facing water erosion issues. Water

erosion is worse in these areas because they get more rain each year and have steep hills, unlike the flatter areas like Lume and Adama. Knowing about geology, land forms, wave and current movements, how sediment moves, human actions, and climate change helps us understand erosion rates, weak spots, and possible ways to reduce damage for specific locations (Saengsupavanich et al., 2023).

## CHAPTER THREE

### 3.0

### METHODOLOGY

#### 3.1. Study area and scope

The study was carried out within the Ughelli North Local Government Area of Delta State, found in the southern region of Nigeria.

The rainforest of Southern Nigeria encompasses Delta State. It is about between 5°00' and 6°45' East and between 5°00' and 6°30' North. It is located in the Midwest region of Nigeria. To the north and west, it touches Edo State for about 350 km (218 miles). On its eastern side, the region is adjacent to Anambra State for around 93 kilometers and Rivers State for roughly 50 kilometers. To the southeast, it meets Bayelsa State across the Niger River for 17 km and the Forcados River for 198 km. On the southern side, it has 160 km of coastline along the Bight of Benin.

Delta State has land mass of 18,050 km<sup>2</sup> (6,970 sq mi), of which more than 60% is land, with a total population of about 5,636,100 million people and population density of 331.8 per square kilometre (NIGERIA: Administrative Division, 2022). The state has 25 local government areas. These areas are Aniocha North, Aniocha South, Oshimili North, Oshimili South, Ika North East, Ika South, Ndokwa East, Ndokwa West, Ukwani, Ughelli North, Ughelli South, Ethiope East, Ethiope West, Isoko North, Isoko South, Patani, Uvwie, Okpe, Sapele, Warri North, Warri South, Warri South West, Udu, Burutu, and Bomadi.

The plant life in the state changes from one area to another. There is a mangrove swamp by the coast in the southern part of the state, evergreen forest in the central areas, and savannah in some parts of the northern regions. Delta State has a hot, tropical climate with two main seasons. The dry season happens from December to April. The rainy season is from May to November, with a brief dry period in August called the "August break. " The average rainfall is around 266. 5 cm in the coastal areas and 190. 5 cm in the northern region, with the most rain falling in July. Delta State gets an average of 36. 9 mm of rain. In 2015, there was more rain than usual, which caused flooding on farms in the area (Oyerinde, 2021). The daily temperature ranges from 20°C to 34°C with an average of about 30°C. The major crops grown include tree crops such as rubber, oil palm, tuber crops such as cassava, yam, melon, groundnut, plantain, cocoyam, pepper, pineapple, oranges and maize. Balogun and Onokerhoraye (2022) stated that a major characteristic of the climate of Delta State is flooding.

### **3.2 Population of the study**

The population of the study are rural dwellers in Ughelli North Local Government Area of Delta State.

### **3.3 Sampling technique and sampling size**

A two stage sampling technique was used in the selection of respondents in this study.

The first stage was a purposive selection of six (6) communities (Evwreni, Uwherun, Ohoro, Ughelli, Orogun and Agbarho) in the L.G.A based on the intensity of water erosion.

The second stage involved the simple random selection of fifteen (15) rural dwellers from each of the selected communities, making up a total sampling size of ninety (90) respondents.

### **3.4 Data collection**

Data for the study was collected with the aid of a structured and validated questionnaire. Ideas from previous research formed the basis for the design of this instrument. This was constructed in such a way that each section solicited responses consistent with the objectives and hypotheses of the study.

Primary data was collected and analyzed for this study. Primary data was collected by means of a structured questionnaire which was administered by the researcher and trained field assistants to respondents.

### **3.5 Measurement of variables**

#### **Dependent Variables**

The dependent variables are:

#### **a. Water erosion control methods practiced by respondents**

Respondents' were asked the water erosion control methods they practiced. This was measured using a scale of Yes (1) No (0).

#### **Independent variables:**

The independent variables for the study are measured as follows:

#### **b. The Socio-economic characteristics**

**Sex:** Indicated by respondents nominally, Male (1), Female (0)

**Age:** Respondents were asked to indicate their age in actual number of years.

**Marital status:** The marital status of respondents was measured nominally as Single (1), Married (0).

**Level of education:** The level of education of the respondents were asked and categorized as No formal education (1), Primary education (2), Secondary education (3), Tertiary education (4).

**Monthly income:** The income level of the respondents were asked and measured at interval level in Naira (N)

**Household size:** Measured by the number of individuals in the house hold of the respondents feeding from the same pot as at the time of research.

**Major occupation:** The primary occupation of respondents was measured nominally as Farming (1), Trading (2), Civil/public service (3), Artisan (4), Others (5).

**c. Level of the respondents' participation in water erosion control**

Respondents were asked on level of participation in water erosion control. The level of respondents' participation in water erosion control activities was measured using a 5-point Likert scale of Always= 5, Sometimes = 4, Undecided = 3, Rarely= 2, Never= 1.

**d. Possible benefits of water erosion control on rural community development**

The respondents were asked the possible benefits of water erosion control on rural community development. This was measured using a scale of Yes (1) No (0).

### **e. Challenges faced by the respondents in practicing water erosion control**

The respondents were asked the challenges they face in practicing water erosion control.

This was achieved using descriptive statistics such as frequency, percentage and mean.

### **3.6 Data Analysis**

Descriptive statistical tools such as frequency counts, mean and percentages were used primarily to describe the socio-economic profile and other variables. While inferential statistics tools such as Binary logistic regression was used to test hypothesis.

#### **Objective 1: Socio-economic characteristics of respondents in the study area**

Descriptive statistics such as mean, percentage, standard deviation and frequency counts were used to achieve this objective.

#### **Objective 2: Water erosion control methods practiced by respondents**

Descriptive statistics such as percentage and frequency counts were used to achieve this objective.

#### **Objective 3: Level of respondents' participation in water erosion control**

A 5-point Likert scale, with responses showing the level of participation of in water erosion control was used to achieve this objective. The highest score is rated 5. A rating of Always participate = 5, Sometimes participate= 4, Undecided = 3, Rarely participate= 2, Never participate= 1.

This was then added to get 15 divided by 5 to get 3 as the cut-off point. Variables with mean score of 3 and above were regarded as participate while less than 2 were regarded as not participate.

**Objective 4:** Possible benefits of water erosion control on rural community development  
Descriptive statistics such as percentage and frequency counts were used to achieve this objective.

**Objective 5:** Challenges faced by the respondents in practicing water erosion control  
This was achieved using descriptive statistics such as frequency, percentage and mean.

### **Test for Hypothesis**

Ho: There is no significant relationship between the socio-economic characteristics of respondents and the water erosion control methods practiced.

Statistical analysis using Logistic regression was used to determine the relationship between the variables. This regression is a predictive statistical method used to model the relationship between a binary or categorical dependent variable and one or more independent variables.

### **Key Formula (Binary Logistic):**

$$P(Y = 1) = 1 / (1 + e^{-(\beta_0 + \beta_1 X_1 + \dots + \beta_n X_n)})$$

Where:

- P = probability of the event
- e = Euler's number (~2.718)
- $\beta_0$  = intercept
- $\beta_1 \dots \beta_n$  = coefficients for predictors  $X_1 \dots X_n$
- Y = the dependent variable (water erosion control methods practiced)
- For binary logistic, Y = 1 (event happens) or Y = 0 (event doesn't happen)

-  $X_1$  to  $X_n$  = the independent variables (predictors)

- These are the factors that may influence  $Y$

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.1 Socio-economic Characteristics**

##### **4.1.1 Sex of respondents**

The result in table 1 indicates a nearly equal distribution of respondents by sex, with females (54.5%) slightly outnumbering males (45.6%). This is a significant finding, as it suggests that women play a substantial role in land management and agriculture in the study area.

##### **4.1.2 Age of respondents**

As shown in table 1, the mean age of sampled respondents was 31 years. However, most (43.3%) of the respondents were found to be 25 years and below, 31.11% of respondents were found within the age bracket of 26-35 years, 13.33% were found within the age bracket of 36-45 years while 12.22% were 45 years and above. This indicates a relatively young sample, with a wide spread of ages from young adults (likely below 25) to middle-aged individuals (up to 57 years old). This indicate, that the study area is characterized by high dependency ratio mainly with young age dependence.

##### **4.1.3 Marital status**

Result shown in table 1 show that majority (70%) of the sampled residents were single(unmarried) while 30% were married.The high percentage of single individuals directly correlates with the young mean age of 31 years.

#### **4.1.4 Level of Education**

Based on the result shown in Table 1, a high percentage of respondents (70%) have attained tertiary education, 20% of the respondents had secondary education, a small fraction (3.3%) had primary education while 6.7% had no formal education. The educational attainment of the respondents is notably high, with 70% having a tertiary education. This is a powerful asset for the community and for any intervention programs.

#### **4.1.5 Household size**

Result in Table 1 showed that 45.6% of the respondents had household size of between 4-6 persons, 30% had household size of 1-3 persons, 21.1% had household size of between 7-9 persons while a small fraction 3.3% had household size of 10 and above. The mean household size is 5 persons ( $\pm 2$ ), which is typical for many rural communities.

#### **4.1.6 Major Occupation**

From the result shown in table 1, 18.9% of the sampled respondents had primary Occupation as farming, 20% had primary occupation as trading/business/entrepreneur and civil service respectively, 11.1% had primary occupation as artisan, 15.6% had primary occupation as students while 14.4% were into other forms of employment.

The primary occupations are diverse, with Farming (18.9%), Trading/Business (20%), and Civil Service (20%) being the most common. This diversification of livelihoods can influence dependency on land and the resources available for investing in erosion control.

#### **4.1.7 Monthly income**

Result shown in Table 1 shows that 22.2% of the sampled respondents had average monthly income below 20,000 naira, 23.3% had average monthly income between 20,001-50,000 naira, 25.6% had average monthly income between 50,001-100,000 naira while 28.9% had average monthly income of above 100,000 naira. The income distribution is relatively even across the brackets, with a slight majority (54.5%) earning above ₦50,000.

**Table 1: Socio-economic characteristics of respondents**

<b>Variables</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>	<b>Mean (Std dev)</b>
<b>Gender</b>	Male	41	45.6
	Female	49	54.5
<b>Age</b>	Below 25 years	39	43.33
	26 – 35 years	28	31.11
	36 – 45 years	12	13.33
	Above 45 years	11	12.22
<b>Marital status</b>	Single	63	70.0
	Married	27	30.0
	Non-formal	6	6.7
<b>Education</b>	Primary	3	3.3
	Secondary	18	20.0
	Tertiary	63	70.0
<b>Household size</b>	1 – 3	27	30
	4 – 6	41	45.6
	7 – 9	19	21.1
	10 Above	3	3.3
<b>Primary occupation</b>	Farming	17	18.9
	Trading/Business/Entrepreneur	18	20.0
	Civil Service	18	20.0
	Artisan	10	11.1
<b>Income</b>	Student	14	15.6
	Others	13	14.4
	Less than 20,000	20	22.2
	20,001 – 50,000	21	23.3
	50,001 – 100,000	23	25.6
Above 100,000	26	28.9	

Source: Field Survey Data, 2025

## **4.2 Water erosion control methods practiced by respondents**

Result in Table 2 shows a high level of diversity in the water erosion control methods practiced, with "Multiple responses" recorded. The most common methods practiced by the sampled respondents were- Proper drainage system (77.8%), this high adoption rate likely reflects a direct response to visible flooding problems, which are immediately damaging to property and crops. Mulching (70.0%) and Cover cropping (63.3%), retention of crop residue mulch, and incorporation of a cover crop (forages) in the rotation cycle while eliminating bare fallows, can conserve soil and water and improve soil organic carbon pool in the surface layer (Lal,2015). Construction of dams (61.1%) and Vegetative cover (60.0%): Under West African conditions, construction of stone bunds and establishment of contour vegetative hedgerows can be effective for water conservation (Thapa & Yila, 2012).

The relatively lower adoption of terracing (51.1%), strip cropping (45.6%) and Contour farming (38.9%) was notable. These methods are highly effective but are often labour-intensive and require significant skill and land modification. Zero/reduced tillage was practiced by more than half of the respondents(55.6%), indicating a moderate to high level of adoption. No-tillage practices are widely considered to conservation tillage (Labreuche et al., 2007). Reducing the intensity of soil tillage decreases energy consumption and the emission of carbon dioxide, while increasing carbon sequestration and soil stability (Holland, 2004). 51.1% practiced building on raised platforms which is

a specific technique to protect infrastructure and homesteads from flooding and waterlogging

Agroforestry was practiced by 54.4% of respondents. Agroforestry controls water erosion primarily through the root systems of trees, which bind the soil, and through the canopy, which lessens the force of rainfall. The high level of practice suggests that respondents in the study area appreciate the multiple benefits agroforestry offers, which extend beyond erosion control to potentially include improved soil fertility, provision of fodder, fruit, and timber, thereby contributing to livelihood diversification.

**Table 2: Frequency distribution of water erosion control methods practiced by respondents in the study area**

<b>Methods</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Terracing	46	51.1
Contour farming	35	38.9
Mulching	63	70.0
Cover cropping	57	63.3
Strip cropping	41	45.6
Zero/reduced tillage	50	55.6
Agroforestry	49	54.4
Proper drainage system	70	77.8
Vegetative cover	54	60.0
Construction of dams	55	61.1
Building on raised platforms	46	51.1

Source: Field Survey, 2025; \*Multiple responses

### 4.3 Awareness of water erosion control methods

Considering Table 3 below, majority ( 84.3%) of the sampled respondents were aware of water erosion control methods while 15.7% were unaware. This is consistent with the high education level of the respondents and suggests that information campaigns or extension services have been somewhat successful in creating awareness.

**Table 3: Respondents' awareness of water erosion control methods**

	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Yes	75	84.3
No	25	15.7

Source: Field Survey, 2025

#### **4.4 Level of respondents' participation in water erosion control methods**

This is where a critical gap was revealed. Results shown in Table 4 using the study's benchmark (Mean score  $\geq 3.0$  = Participation), indicates that only four out of eleven methods cross the threshold for consistent participation by the sampled respondents- proper drainage system with a mean value (3.47) mulching (3.28), vegetative cover with a mean value (3.22), Cover cropping with a mean value (3.02). In a study conducted in Kogi by Onu and Mohamed (2014) on soil erosion prevention and control, it was revealed that mulching, cover cropping, strip cropping and contour bonding were the local controls for soil erosion.

Agroforestry with a mean value (2.79), terracing with a mean value of (2.74), contour farming with a mean value of (2.47), strip cropping with a mean value of (2.68), zero/reduced tillage with a mean value of (2.78), had moderate participation as these methods fail to meet the benchmark mean (3.0). The methods with the lowest participation are the more structural ones- construction of dams with a mean value (2.34) and building on raised platforms with a mean value (2.44).



**Figure 1: Drainage under construction.**



**Figure 2: Mulching of a farmland.**



**Figure 3: Proper drainage and cover cropping common water erosion control methods practiced in the study area.**



**Table 4: Frequency and level of respondents' participation in water erosion control methods**

Methods	Frequency (Percentage)					Mean (Std. Dev)
	Never	Rarely	Undecided	Sometimes	Always	
Terracing	26 (28.9)	20 (22.2)	3 (3.3)	33 (36.7)	8 (8.90)	2.74 (1.434)
Contour Farming	33 (36.7)	21 (23.3)	7 (7.8)	19 (21.1)	10 (11.1)	2.47 (1.447)
Mulching	20 (22.2)	15 (16.7)	6 (6.7)	18 (20.0)	31 (34.4)	3.28 (1.608)
Cover cropping	25 (27.8)	13 (14.4)	9 (10.0)	21 (23.3)	22 (24.4)	3.02 (1.579)
Strip cropping	31 (34.4)	17 (18.9)	10 (11.1)	14 (15.6)	18 (20.0)	2.68 (1.4564)
Zero/Reduced tillage	29 (32.2)	13 (14.4)	9 (10.0)	27 (30.0)	12 (13.3)	2.78 (1.497)
Agroforestry	29 (32.2)	15 (16.7)	7 (7.8)	24 (26.7)	15 (16.7)	2.79 (1.540)
Proper drainage system	18 (20.0)	12 (13.3)	4 (4.4)	22 (2.4)	34 (37.8)	3.47 (1.581)
Vegetative cover	17 (18.9)	14 (15.6)	12 (13.3)	26 (28.9)	21 (23.3)	3.22 (1.452)
Construction of Dams	38 (42.2)	16 (17.8)	12 (13.3)	15 (16.7)	9 (10.0)	2.34 (1.423)
Building on raised platforms	35 (38.9)	12 (13.3)	17 (18.9)	20 (22.2)	6 (6.7)	2.44 (1.375)

Source: Field Survey, 2025; Mean score  $\geq 3.0$  = Participation; \*Multiple responses

#### 4.5 Training received by respondents

Results in Table 5 showed that only 36% of the sampled respondents received formal training while 64% received no form of training. This is a crucial finding. The lack of hands-on training is a major barrier to the effective implementation of more technical methods like terracing or contour farming, even if respondents are broadly aware of them. Abebe and Sewnet (2014) and Asfaw and Neka (2017) reported that participation in training could positively influence the adoption and management of physical SWC measures in West Gojam and South Wollo areas, Ethiopia.

**Table 5: Training received by respondents**

	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Received training Yes	32	36.0
No	68	64.0

#### **4.6 Possible benefits of water erosion control on rural community development**

Results shown in Table 6 indicates that respondents perceive very strong benefits from erosion control, particularly in non-production areas. The highest perceived benefit was reduced flooding (95.6%), underscoring the immediate threat that water damage poses to communities. This is followed by agricultural productivity (85.6%) and protection of roads/infrastructure (82.2%). The recognition of benefits for infrastructure, general livelihood (81.1%) and prevention of gully formation (72.2%), shows a holistic understanding of how soil conservation contributes to broader community resilience and rural development, beyond just farm output.

The perceived and observed soil erosion could have a considerable effect on farmers' livelihood and rural development, showing the need for appropriate land management practices ( Betela and Wolka, 2021). Increased soil fertility (9.4%), this small fraction might be an indication that majority of the sampled respondents were unaware of the positive impact of controlling water erosion on soil fertility.

**Table 6: Respondents' perceived benefits of water erosion control method on rural community development**

<b>Areas</b>	<b>Frequency</b>	<b>Percentage</b>
Agricultural Productivity	77	85.6
Increased Soil fertility	85	9.4
Reduced Flooding	86	95.6
Protection of Roads/Infrastructures	74	82.2
Prevent gully formation	65	72.2
General livelihood improvement	73	81.1

Source: Field Survey, 2025; \*Multiple responses

#### **4.7 Challenges faced by respondents in practicing water erosion control**

According to the results shown in Table 7 the sampled respondents identified lack of materials (81.1%) and lack of funds (75.6%) as the top constraints. This highlights the financial and input-based barriers to adoption. Many effective erosion control structures require materials (e.g., for drainage, dams, terraces) that are costly or locally unavailable. Time constraint (74.4%), labour shortage (72.2%), and poor government support (73.3%), geographical limitation (73.3%) point to structural and institutional failures. The high labour demand for these practices' conflicts with the time constraints of a population with diversified livelihoods. The perceived lack of government support is a critical finding, suggesting a need for subsidies, provision of materials, or targeted extension programs. Lack of knowledge (58.9%), while the lowest, still affects a majority.

**Table 7: Challenges faced by respondents in practicing water erosion control**

<b>Challenges</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Lack of funds	68	75.6
Lack of knowledge	53	58.9
Labour shortage	65	72.2
Lack of materials	73	81.1
Poor government support	66	73.3
Time constraint	67	74.4
Geographical limitation	66	73.3

Source: Field Survey, 2025; \*Multiple responses

## 4.8 Test of hypothesis

### **Relationship between socio-economic characteristics of rural dwellers and water erosion control methods practiced.**

Results of logistic regression as depicted in Table 8 showed that there is significant relationship between the selected socio-economic characteristics of respondents and water erosion method practiced. However, this is only true for seven out of the eleven various water erosion control methods included in the study. The hypothesis is partially supported. The results clearly show that specific respondent characteristics are significant predictors for the adoption of some water erosion control methods.

There is no single characteristic that influences all methods, indicating that the adoption of soil conservation practices is complex and method-specific.

1. Terracing: Regression of age ( $\beta=0.073$ ,  $p=0.043$ ), household size ( $\beta=0.233$ ,  $p=0.044$ ), primary occupation ( $\beta=-2.539$ ,  $p=0.011$ ) were all significant at either 5% or 1% level of probability. Primary occupation with  $\beta=-2.539$ , this is a strong negative predictor.
2. Zero/Reduced Tillage: Regression of household size ( $\beta=0.203$ ,  $p=0.078$ ), primary occupation ( $\beta=2.690$ ,  $p=0.031$ ) were all significant at either 5% or 1% level of probability.
3. Proper Drainage System: Regression of household size ( $\beta=0.228$ ,  $p=0.088$ ) was significant at 1% level of probability. Farmers with larger holdings are more likely to

practice measures for soil erosion control than those with smaller holdings because adoption costs relative to farm size are lower (Gbigbi, 2020).

4. Vegetative Cover: Regression of age ( $\beta=0.058$ ,  $p=0.087$ ), primary occupation ( $\beta=-1.970$ ,  $p=0.081$ ), Income ( $\beta=1.773$ ,  $p=0.019$ ) were all significant at either 5% or 1% level of probability. Farmers among the sampled respondents were less likely to use this method as they might perceive it as competing with crops for space/nutrients. While individuals among the sampled respondents with high monthly income are significantly more likely to adopt vegetative cover. This is justified by previous study done by Gimechu (2016), according to this study the highest percentage of the farmers in the study area (32.5%) agreed that the reason for the inability to conserve their land was lack of capital followed by poverty 28.3%.

5. Construction of Dams: Regression of sex ( $\beta=-1.405$ ,  $p=0.033$ ) and income ( $\beta=1.514$ ,  $p=0.050$ ) were both significant at 5% level of probability. Males among the sampled respondents were less likely to adopt dam construction than women. This is contrary to the findings of Asfaw & Neka (2017), which states by the fact that the most of the practices require physical effort and additional work on the part of the adopter. Women are more charged to the housework and housekeeping (Asfaw & Neka, 2017) This is a very interesting finding It could be that women, who are often responsible for water collection and domestic gardens, are more directly motivated to invest in water-harvesting structures like dams. Also individuals vegetative cover with high income

practiced more of this method of water erosion control. Building dams is a capital-intensive activity, requiring resources for materials and possibly hired labor, putting it out of reach for poorer households.

6. Building on Raised Platforms: Regression of sex ( $\beta=-1.083$ ,  $p=0.056$ ) Was significant at 1% level of probability.

7. Agroforestry:

Regression of age ( $\beta=0.05$ ,  $p=0.093$ ) was significant at 1% level of probability.

Older members of the sampled population practiced this method, as they may have more years of experience.

**Table 8: Determinant Matrix showing significant variables and Control Methods**

Variables	Terracing			Zero tillage			Proper drainage system			Vegetative cover			Dams			Building on raised platforms			Agroforestry		
	β	S.E	P-value	β	S.E	P-value	β	S.E	P-value	β	S.E	P-value	β	S.E	P-value	β	S.E	P-value	B	S.E	P-value
age	0.073	0.36	0.043**							.058	.034	.087*							.056	.034	.093*
sex													-1.405	.661	.033**	-1.083	.567	.056*			
Household size	0.233	0.116	0.044**	.203	.115	.078*	.228	.133	.088*												
primary occupation	-2.539	.998	.011**	2.690	1.250	.031**				-1.970	1.130	.081*									
Monthly income										1.773	.753	.019**	1.514	.773	.050**						
<b>Constant</b>																					
-2 Log likelihood	98.780 <sup>a</sup>			88.510 <sup>a</sup>			79.489 <sup>a</sup>			102.459 <sup>a</sup>			100.370 <sup>a</sup>			115.357 <sup>a</sup>			106.746 <sup>a</sup>		
Cox & Snell R Square	0.250			0.323			0.162			0.187			0.199			0.099			0.175		
Nagelkerke R Square	0.334			0.433			0.247			0.253			0.269			0.132			0.234		

Source: Field Survey Data, 2025

\*Significant at (P < 0.1); \*\* Significant at P < 0.05

### **Model Fit and Statistical Notes**

The Hosmer and Lemeshow Test shows non-significant p-values (all  $>0.05$ ) for all models, which indicates that the models are a good fit for the data (i.e., the predicted probabilities match the observed probabilities well). The Pseudo R-Square values (Cox & Snell and Nagelkerke) vary widely. Methods like Zero Tillage (Nagelkerke  $R^2=0.433$ ) and Terracing (0.334) are reasonably well-explained by the predictors, while others like Building on Raised Platforms (0.132) are poorly explained, meaning other important factors not included in the model influence their adoption.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Summary**

This study aimed to evaluate the methods used by rural dwellers to combat water erosion, a severe environmental threat in the region. The study was driven by the need to address soil degradation, loss of agricultural productivity, and infrastructure damage caused by erosion, which disproportionately affects rural, agriculture-dependent communities.

The study employed a mixed-methods approach, utilizing a structured questionnaire to collect primary data from 90 respondents selected through a two-stage sampling technique from six communities (Evwreni, Uwherun, Ohoro, Ughelli, Orogun, and Agbarho) known for high erosion intensity. Data analysis involved descriptive statistics (frequencies, percentages, means) to profile the respondents and their practices, and inferential statistics (binary logistic regression) to test the hypothesis that there is no significant relationship between socio-economic characteristics and the adoption of erosion control methods.

The result shows that 43.3% of the sampled respondents consist of a youthful population of age 25 years and below- This shows a youthful population with potential for active participation in erosion control. Most (54.5% and 70%) of the sampled respondents are female and unmarried respectively. 6.7% of the sampled respondents have no formal

education, while 93.3% has at least primary education. The sampled respondents also showed an average household of two (2).

The findings of this research also showed that, the sampled respondents Respondents practiced diverse erosion control methods, often in combination. 84.3% of sampled respondents were aware of erosion control methods, reflecting high information dissemination but only four methods—proper drainage (3.47), mulching (3.28), vegetative cover (3.22), and cover cropping (3.02)—showed high participation (mean  $\geq$  3.0). Respondents recognized significant benefits of water erosion control.

The result of binary logistic regression indicated that there is significant relationship between the selected socio-economic characteristics and the water erosion control methods practiced by respondents.

## **5.2 Conclusion**

The study concludes that rural dwellers in Ughelli North L.G.A. are highly aware of water erosion and its detrimental effects and possess good knowledge of various control methods. There is also a strong recognition of the multiple benefits these methods bring to agricultural productivity and community development. Community leadership plays a central role in disseminating this knowledge.

However, a significant gap exists between knowledge and consistent implementation. This implementation gap is primarily driven by formidable socio-economic and

institutional constraints, with financial limitations and insufficient government support being the most critical. The fact that the most adopted methods (drainage, raised platforms) are often immediate, protective measures for homesteads, while more agricultural-based methods like terracing and contour farming are practiced less frequently, suggests that respondents prioritize protecting their immediate living areas, possibly due to a lack of resources to invest fully in farmland conservation.

The mixed results from the regression analysis underscore that the adoption of erosion control is not a straightforward function of socio-economic status but is a complex decision influenced by experience (as seen with age), gender roles, specific knowledge, and, most importantly, the presence or absence of critical support systems and resources.

### **5.3 Recommendations**

Having considered the findings of this research, the following recommendations were made;

#### **1. Capacity Building and Training:**

Government agencies working hand in hand with community leaders and NGOs should organize regular, practical training workshops to equip farmers with hands-on knowledge of effective erosion control techniques, especially terracing, contour farming, and dam construction.

#### **2. Subsidies and Financial Support:**

Provide grants, subsidies, or low-interest loans to help farmers and rural residents afford materials and labour needed for erosion control projects. Establish community revolving funds to support group-based erosion control initiatives.

### 3. Strengthening Extension Services:

Agricultural extension officers should intensify field demonstrations and awareness campaigns to close the “knowledge-practice gap.”

Use local radio, social media, and farmer field schools for information dissemination.

### 4. Community-Based Approaches:

Encourage the formation of community erosion control committees to promote collective action in constructing and maintaining drainage systems and vegetative barriers.

### 5. Infrastructure Development:

Government should invest in rural drainage systems, small dams, and road maintenance to mitigate erosion impacts and improve resilience.

### 7. Monitoring and Evaluation:

Implement a local monitoring framework to assess the effectiveness and sustainability of adopted erosion control measures over time.

### 8. Policy and Institutional Support:

Integrate erosion control into local land-use planning and rural development policies, ensuring long-term institutional backing and funding.

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**APPENDIX**  
**QUESTIONNAIRE**  
**DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION**  
**SERVICES**  
**FACULTY OF AGRICULTURE**  
**UNIVERSITY OF BENIN**

Dear Sir/Madam,

I am an undergraduate student of the above-named institution carrying out research to gather useful information on the topic: “**Assessment of Water Erosion Control Methods in Rural Communities in Ughelli North Local Government Area of Delta State, Nigeria**”. I hereby solicit your assistance by responding to the questions below accurately, this questionnaire is strictly for academic purposes. Your responses will be kept confidential and used solely for research.

Thanks for your cooperation.

Yours faithfully,

**Jerry Otuya ASOHRO**

**INSTRUCTION:** Please tick (✓) or fill in where applicable.

**Section A: Socio-Economic Characteristics**

1. Age: \_\_\_\_\_ years

2. Sex: Male [ ] Female [ ]

3. Marital Status: Single [ ] Married [ ]

4. Educational Level: No formal education [ ] Primary education [ ]

Secondary education [ ] Tertiary education [ ]

5. Household size (Number of persons feeding from same plate): \_\_\_\_\_ persons

6. Primary Occupation: Farming [ ] Trading [ ] Civil service [ ] Artisan [ ]

Others (specify): \_\_\_\_\_

7. Monthly Income: Less than ₦20,000 [ ]

₦20,000–₦50,000 [ ] ₦50,001–₦100,000 [ ] Above ₦100,000 [ ]

**Section B: Water Erosion Control Methods**

8. Which water erosion control methods do you practice in your farmland? Yes (1) No (0)

Please tick (✓)

S/N	Control methods	Yes	No
1	Terracing– to make or form sloping land into a number of steps to reduce water flow.		
2	Contour farming– planting along the natural curves (contours) of the land to slow water flow.		
3	Mulching– covering the soil with organic materials (leaves,grasses) to retain moisture and reduce erosion.		
4	Cover cropping – growing plants (like legumes)to protect the soil between main crops.		
5	Strip cropping – growing crops with deep roots and high canopy density in alternating strips(narrow area of land).		
6	Zero/reduced tillage–Minimizing or avoiding soil disturbance to conserve structure and moisture.		
7	Agroforestry – planting trees/shrubs together with crops to reduce water flow.		
8	Proper drainage system –Channels or pipes that direct excess water away safely to prevent washouts.		
9	Vegetative cover –Planting grass, shrubs, or trees to protect soil from rain impact and reduce water flow.		
10	Construction of dams (using stones, wood or earth) –Forming small barriers that slow or store water to prevent downstream erosion.		
11	Building on raised platform –Elevating structures to avoid damage from runoff or flooding.		
12	Others (please specify):		

**Section C: Level of Participation in Water Erosion Control**

9. Are you aware of water erosion control measures? Yes [ ] No [ ]

10. How often do you participate in water erosion control? Please tick (✓)

S/N	Control methods	Always participate	Sometimes participate	Undecided	Rarely participate	Never participate
1	Terracing					
2	Contour farming					
3	Mulching					
4	Cover cropping					
5	Strip cropping					
6	Zero/reduced tillage					
7	Agroforestry					
8	Proper drainage system					
9	Vegetative cover					
10	Construction of dams					
11	Building on raised platform					
12	Others (specify):					

**Key: Always participate (5) Sometimes participate (4) Undecided (3) Rarely participate (2) Never participate (1)**

11. Have you received training on water erosion control? Yes [ ] No [ ]

12. If yes, who provided the training? Government Extension Agent [ ] NGO [ ]

Farmers Group [ ] Community Leader [ ] Other: ( please specify)

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**Section D: Possible Benefits of Water Erosion Control on Community Development**

13. Water erosion control has helped in community development? Yes (1) No (0)

Please tick (✓)

S/N	Areas of water erosion control on community development	Yes	No
1	Agricultural productivity		
2	Increased soil fertility		
3	Reduction in flooding		
4	Protection of roads and other infrastructures		
5	Prevention of gully formation		
6	General livelihood improvement		
7	Others (please specify):		

### Section E: Challenges in Implementing Water Erosion Control

14. What challenge(s) do you face in water erosion control? Please tick (✓)

S/N	Challenges	Yes	No
1	Lack of funds		
2	Lack of knowledge		
3	Shortage of labour		
4	Lack of materials		
5	Poor government support		
6	Lack of community support		
7	Time constraints		
8	Geographic limitations		
9	Others (please specify):		

**Key: Yes (1) No (0)**